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Science Advisory Report 2008/039

ASSESSMENT OF SCALLOPS (*PLACOPECTEN MAGELLANICUS*) IN SCALLOP FISHING AREA (SFA) 29 WEST OF LONGITUDE 65°30'W

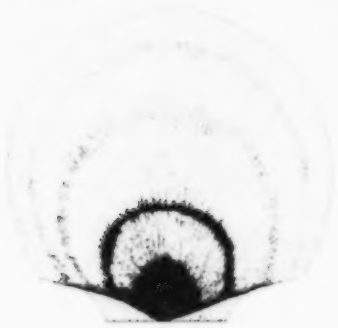

Figure 1. Location of the portion of SFA 29 west of longitude 65°30'W. Refer to full detail map in Appendix 1 for locations and place names.

Context

Scallop Fishing Area (SFA) 29 encompasses a very large inshore area inside the 12-mile territorial sea, from the south of Yarmouth (latitude 43°40'N) to Cape North in Cape Breton. This report refers to only that portion of SFA 29 west of longitude 65°30'W continuing north to SPA 3 at latitude 43°40'N.

Prior to 1986, the Full Bay Scallop Fleet fished in this area. Following the 1986 inshore/offshore scallop fishing agreement, fishing by the Full Bay Fleet was restricted to north of latitude 43°40'N. A limited fishery by the Full Bay Fleet was granted from 1996–98. Access was again granted to this fleet in 2001 with a full at-sea monitoring program and with a condition of a post-season industry-funded survey. SFA 29 is within Lobster Fishing Area (LFA) 34 and, as a result, scallop fishers consulted with lobster fishers in the area to deal with potential conflicts. Lobster and bycatch of other species continue to be monitored in this fishery.

In 2002, the Minister of Fisheries and Oceans approved access to this area by the Full Bay Fleet and inshore east of Baccaro licence holders who are eligible to fish in SFA 29 west of longitude 65°30'W. SFA 29 inshore scallop licenses were historically restricted to east of Baccaro (east of longitude 65°30'W). A joint project agreement was signed with the fishing fleets, Natural Resources Canada, and Fisheries and Oceans Canada with all parties providing funds to conduct multi-beam acoustic mapping of the seafloor and other scientific work. A map showing bottom features for the entire area has been prepared and was distributed to the fishermen for the 2004 fishery. Work continues on analyzing surficial geology and the spatial distribution of scallops.

Advice on TACs for this area has been provided annually and is based on survey estimates of abundance and commercial catch rates. There is no framework or reference points for the fishery in SFA 29 at this time.

Canada

SUMMARY

- This is the seventh consecutive year that a scallop fishery has been conducted in the portion of Scallop Fishing Area (SFA) 29 west of longitude 65°30' W. Starting in 2002, the TAC was shared between the Full Bay Fleet and a limited number of inshore East of Baccaro licence holders who are eligible to fish in SFA 29 west of longitude 65°30' W (i.e., East of Baccaro Fleet).

- During 2007, a total of 246 t (183 t Full Bay; 63 t East of Baccaro) was landed against a TAC of 250 t.

- Average meat weights from the 2007 fishery ranged from 21.9 g to 29.7 g. Overall, average meat weights are higher this year with the larger meat weights coming from Subareas B and D.

- Commercial catch rates have declined since the first years of the fishery but have stabilized since 2005 in Subareas A, B and C and since 2006 in Subarea D.

- Estimates from the daily commercial catch rate in 2007 indicated that median exploitation rate was highest for Subarea A (0.54). This high rate may be more indicative of local conditions than the whole subarea as fishing was limited to just a few locations in A. The median exploitation rates for the other subareas were 0.21 for C, 0.16 for D and 0.13 for B.

- Survey abundance estimates for commercial size scallops (≥100 mm) and recruits (90–99 mm) have declined since the first years of the fishery. The survey indices do not appear to track year-classes which makes it difficult to interpret trends.

- Survey catches of 1 and 2 year old scallops (shell heights ≤ 50 mm) were widely distributed, with the highest densities in Subarea A. Abundance estimates of this size class are qualitative at best given the selectivity of the survey gear and the actual strength of these year-classes will need to be confirmed by the 2008 survey.

- Based upon the survey estimates of scallops in the 90–99 mm shell height range, the abundance of commercial size scallops in 2008 is not expected to be greater than it was in 2007. The next above-average year-class expected to recruit to the fishery will not be commercial size until 2010 or 2011. Therefore the population numbers are expected to stay the same or decline until then depending upon the rates of exploitation and natural mortality over the next two years.

- Keeping exploitation rates in 2008 at levels in the range of the expected growth in biomass in Subareas B, C and D should result in small or negligible declines in population biomass. That is, catches for 2008 should be in the order of 65, 22, and 61 t for Subareas B, C and D, respectively. Applying the same rationale to Subarea A would result in a recommended catch of less than 1 t. As noted earlier, the exploitation estimate for Subarea A probably does not reflect the area as a whole and the recommended catch could be higher. However, given the high densities of the scallops with shell heights less than 50 mm that were observed in Subarea A, the fishery should be limited to improve the survival of the young scallops in this area.

- There was not enough survey information to recommend catch levels for Subarea E. Scallop landings from this subarea have ranged from 0 to 11 t since this fishery opened in 2001, and it is likely that the habitat in this subarea is marginal for scallop.

- Bycatch of lobster by the SFA 29 scallop fishery in 2007 was estimated at less than 0.1% of the number of lobsters landed by the Lobster Fishing Area (LFA) 34 lobster fishery in the SFA 29 area. The majority of the lobsters caught in the scallop fishery were released back into the water alive and uninjured.

BACKGROUND

Species Biology

The sea scallop (*Placopecten magellanicus*) occurs only in the northwest Atlantic Ocean from Virginia north to Labrador. Within this area, scallops are concentrated in persistent, geographically discrete aggregates or "beds", many of which support valuable commercial fisheries. Scallops in different beds, and in different areas of large beds, show different growth rates and meat yields.

Unlike many commercial scallop species, the sea scallop has separate sexes. Male scallops develop a white gonad in the summer months, while female gonads are bright red. Eggs and sperm are released into the water and fertilization takes place in the sea. Spawning begins in late August to early September, and the larvae drift in the water for almost a month before settling to the bottom in October.

Rationale for Assessment

A meeting of the Regional Advisory Process was held 30 April 2008 at the Bedford Institute of Oceanography (BIO), in Dartmouth, Nova Scotia to review the 2007 fishery and assess the status of the scallop stock in SFA 29 in support of the management of the 2008 fishery. Participants included DFO scientists and fishery managers, representatives of the industry and provincial governments. Specifically, the meeting was called to provide TAC advice for SFA 29 scallop fisheries by subarea using analyses of catch rate and survey biomass trends. In addition, an assessment of the potential for bycatch, particularly lobster bycatch was also provided.

ASSESSMENT

Fishery

This is the seventh consecutive year that a scallop fishery has been conducted in the portion of Scallop Fishing Area (SFA) 29 west of longitude 65°30' W. Starting in 2002, the TAC was shared between the Full Bay Fleet and a limited number of inshore east of Baccaro licence holders who are eligible to fish in SFA 29 west of longitude 65°30' W (i.e., East of Baccaro Fleet).

All subareas but D opened for the 2007 fishing season on June 11 while Subarea D opened two days later. Subareas D and C closed on June 22 and July 10, respectively, with the total landings over-running the quotas in both cases (Table 1). The remaining two subareas closed on July 21 with quota remaining in each subarea.

A total of 25 meat weight samples were collected from the fishery with more than one half of the samples representing catches of the East of Baccaro fleet. This has been the best sample coverage of the East of Baccaro fleet to date. However, no samples from either fleet were obtained from Subarea A. Average meat weights from the 2007 fishery ranged from 21.9 g to 29.7 g. Overall, average meat weights are higher this year with the larger meat weights coming from Subareas B and D.

Observer coverage of one day per active vessel is required for this fishery. This level of coverage was attained by the Full Bay fleet but there was no coverage of the East of Baccaro fleet in 2007. Observers were in short supply due to the department's priority of having 100% coverage of the groundfishery on Georges Bank at the same time as the SFA 29 scallop fishery. There were also contractual/financial issues with arranging observers for the East of Baccaro boats.

Table 1. Scallop landings (meats, t) for SFA 29.

		Full Bay		East of Baccaro		Total	
Year	Subarea	TAC	Landings	TAC	Landings	TAC	Landings
2001	Total	400	400			400	400
2002	29A	75	1	25	4	100	5
	29B	150	193	50	75	200	268
	29C	375	334	125	106	500	440
	Total	600	528	200	185	800	713
2003	29A						
	29B	150	114	51	38	201	152
	29C	188	33	63	32	251	65
	29E		2		2		4
	Total	338	149	114	72	452	221
2004	29A	150.0[1]	70.2	50.0[1]	9.9	200[1]	80.1
	29B		33.1		46.8		79.9
	29E		0.2		3.4		3.6
	29C	187.5	123.8	62.5	35.2	250	159.0
	29D	112.5	148.6	37.5	40.0	150	188.6
	Total	450.0	375.9	150.0	135.3	600	511.2
2005	29A	45.0	2.5	15.0	2.2	60	4.7
	29B	30.0	22.7	10.0	26.3	40	48.9
	29C	75.0	91.9	25.0	23.4	100	115.3
	29D	41.25	63.2	13.75	10.7	55	73.9
	29E		8.8		1.7		10.5
	Total	191.25	189.1	63.75	64.3	255	253.3
2006	29A	18.75[3]	20.4	6.25[3]	1.1	25[3]	21.5
	29E		0.8		1.0		1.8
	29B	93.75	87.8	31.25	27.8	125	115.6
	29C	75.00	85.7	25.00	25.6	100	111.3
	29D	112.50	113.0	37.50	42.9	150	155.9
	Total	300	307.7	100	98.4	400	406.1
2007[2]	29A	18.75[3]	10.49	6.25[3]	0.99	25[3]	11.48
	29E		0.24				0.24
	29B	75.00	55.56	25.0	24.32	100	79.88
	29C	37.50	47.86	12.5	11.03	50	58.89
	29D	56.25	69.00	18.75	26.35	75	95.35
	Total	187.50	183.15	62.50	62.69	250	245.94

[1] TAC for 29A, B and E combined.
[2] Preliminary landings.
[3] TAC for 29A and E combined.

Resource Assessment

Average **commercial catch rates** over the whole area have declined since the opening of the fishery in 2001, with the rate of decline being higher for the Full Bay Fleet compared to the East of Baccaro Fleet (Fig. 2). Overall, catch rates have stabilized for both fleets since 2005 in subareas A, B and C and since 2006 in Subarea D. Subarea D continues to have higher catch rates than the other subareas. However, the catch rates for all subareas still exceed recent levels reported for the Bay of Fundy scallop fishery (10 to 20 kg/h, DFO 2008).

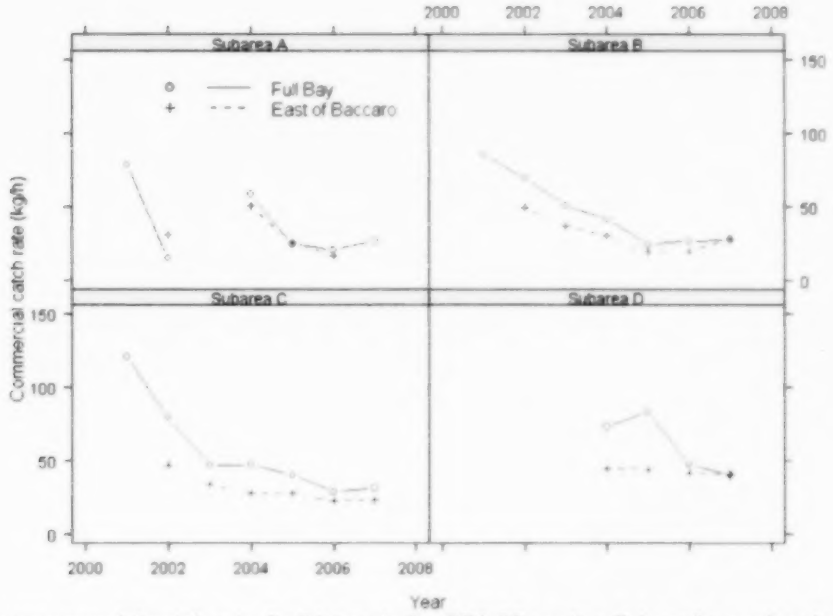

Figure 2. Mean commercial catch rate (kg/h) trends for SFA 29 scallop fishery for each subarea by fleet.

A depletion model was fit to the daily commercial catch rate data to estimate exploitation in 2007. One of the main assumptions for this model is that all of the removals from a population during the season were only due to the fishery. Given the short season for this fishery this assumption should be met. The daily catch rate in subarea A declined by more than half over the period of the fishery for a total catch of 11.5 t. Median exploitation for Subarea A for 2007 was estimated at 0.54 (95% credible bounds of 0.31 and 0.69). This high rate may be more indicative of local conditions than the whole subarea, as fishing was limited to just a few locations in A.

The catch rate decline in Subarea B was more gradual and median exploitation was estimated to be 0.13 (95% credible bounds of 0.01 and 0.26) for a catch of 80 t. Catch rates declined more in Subareas C and D (Fig. 2) than in B with median exploitation at 0.21 (95% credible bounds of 0.03 and 0.39) and 0.16 (95% credible bounds of 0.01 and 0.40), respectively.

A post-season joint industry/departmental **research survey** has been conducted each year since 2001. During this time, there have been four industry vessels involved. In 2001, the survey was based upon a simple random sampling design over the whole area. From 2002 to 2004, Subareas A–E were defined to be strata, with random sampling within strata. Subarea E has not been consistently covered in the survey due to time limitations; this subarea is considered to be marginal habitat for scallops and, as a result, has been less of a survey priority. In 2005, stratification was based upon the surficial bottom types identified from the

multi-beam mapping and surficial geology groundtruth analysis in SFA 29. Beginning in 2006, tows have been allocated randomly to surficial strata within subareas.

Time trends for commercial size scallops (≥100 mm shell height) and recruits (90–99 mm shell height) are plotted in Figure 3. Scallops with shell heights between 90 and 99 mm in 2007 are expected to grow to commercial size in 2008 and are mainly limited to subarea C, compared to 2003 to 2006 when this size class was abundant and widespread throughout C and D. Survey abundance estimates for commercial size scallops and recruits continue to be at or near their lowest levels in the time series. As was noted in last year's assessment it is very difficult to follow cohorts in the shell height frequency data, especially in subareas B and D where large numbers in commercial size abundance (2002 in B and 2005 in D) were not preceded by large numbers of recruits. As a result, population models using these survey data have not been useful.

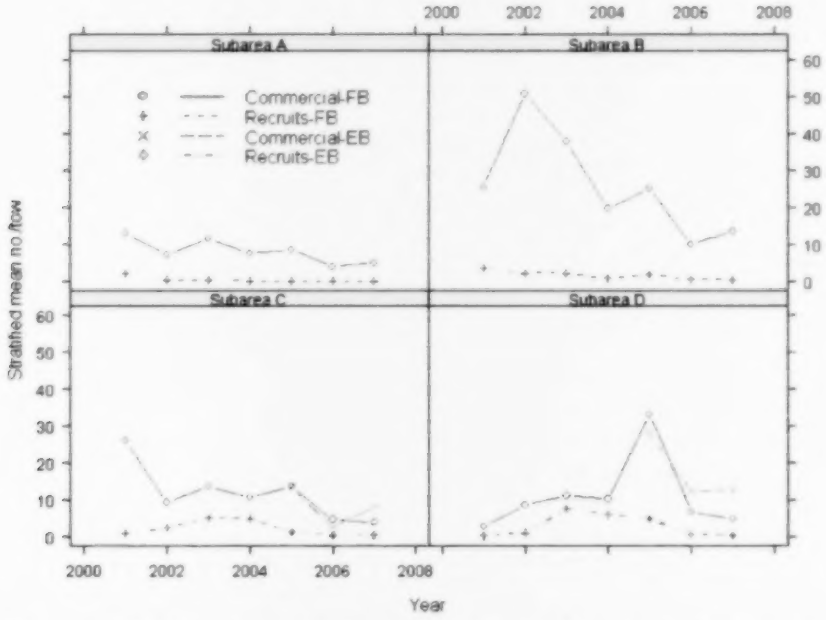

Figure 3. Annual trends of fully recruited (≥100 mm) and recruit (90–99 mm) size scallop mean number per tow from research surveys by subarea in SFA 29. Commercial-FB and Recruits-FB estimated from the Full Bay (FB) industry vessels: F/V Julie Ann Joan (2001–2003, 2005–2007) and F/V Branntelle (2004). Commercial-EB and Recruits-EB estimated from the East of Baccaro (EB) industry vessels: F/V Overton Bay (2005) and F/V Faith Alone (2006, 2007).

The most noteworthy observation from the 2007 survey was the abundant and widespread distribution of scallops of 1 and 2 years old (<50 mm shell height). These scallops were found throughout the area, with the highest densities in Subarea A, and are of similar shell size to those found throughout SPA 3 in the June survey (DFO 2008). Abundance estimates of this size class are qualitative at best given the selectivity of the gear and the actual strength of these year-classes will need to be confirmed by the 2008 survey.

Lobster Bycatch

The mean numbers of lobsters per tow from the scallop survey was highest in subarea B at approximately 3 lobsters per tow (Fig. 4). Subarea B has had the highest catch rate of lobsters

for most of the series. In subareas A, D and C the catch rate was generally less than 1 lobster per tow. The SFA 29 survey was conducted in September during 2001–2003 and in October during 2004–2007; the impact of survey timing on lobster bycatch is unknown.

The regular monitoring by onboard observers of lobster bycatch from this fishery is unique relative to other scallop fisheries. Observer coverage was required for both fleets at a rate of one observed day per active vessel per fishing season. There were a total of 41 days with observer data and all of these were for the Full Bay fleet. With respect to fishing days observed, this represents 3.5% of the days in SFA 29 in 2007, down from the 3.8% coverage in 2006. In previous years, observer coverage ranged from 8 to 21% of the fishing days.

Most lobsters caught during observed fishing trips were in Subarea B similar to previous years (Fig. 5). In Subarea A, C and D most tows had zero lobsters. Of the 194 lobsters caught during observed trips as bycatch in 2007, 126 were uninjured, 34 were injured, 4 were dead and the condition was not recorded for 30. The estimated total number of lobsters caught as a bycatch during scallop fishing in SFA 29 was 5396. This number of lobsters would represent a small fraction (<0.1%) of the lobsters landed by the LFA 34 lobster fleet in the area corresponding to SFA 29 in 2006/2007.

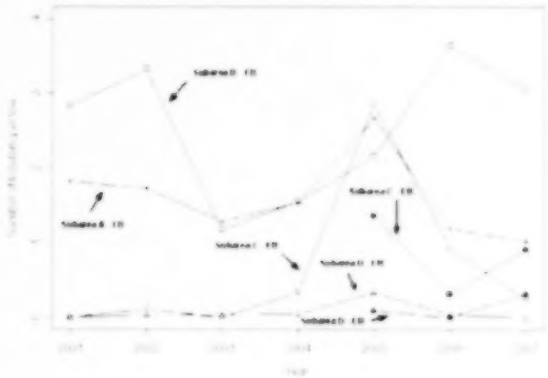

Figure 4. Mean number of lobsters per tow from annual scallop surveys of SFA 29.

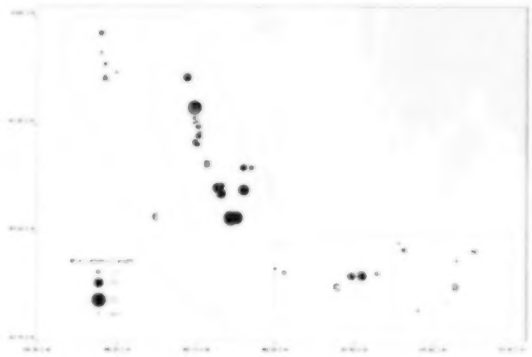

Figure 5. Location and number of lobsters caught in SFA 29 during 2007 from observed scallop fishing trips. Crosses indicate locations where no lobsters were captured.

Other Bycatch

In addition to lobsters, observers onboard the scallop fishing vessels also record the other invertebrates and fish species that are caught with the scallops. A total of 113 types of animals, many only identified to the genera or family level, have been recorded in the bycatch of this fishery since 2001. The observers do not record the condition of these animals and there are no data on the survival rate of these animals once they have been returned to the water.

Estimated catch weights of bycatch species are approximate as the observers generally record the lowest weights as one kilogram. It is likely that the catch weights of smaller animals (e.g., sculpins and crabs) were overestimated because of this practice. Also, observer coverage in 2007 was low relative to 2001–2005 and estimates of bycatch are likely to be less reliable than estimates from those years.

The species with the highest mean bycatch over the 2001–2007 period were Jonah and rock crabs, at 13 t and 12 t, respectively. The estimated catch of 18 t for hermit crabs in 2007 does not seem to be reasonable and probably reflects the practice of setting the lowest weight to one kilogram. Sculpins, skates, monkfish and flounder are the other major groups of species in the bycatch of the scallop fishery. With the exception of sculpins these were the same species identified in the presence/absence results presented last year (DFO 2007). As was noted in the last assessment, the identification of the different species of skate should be treated with caution.

The bycatch of commercial gadoid species were among the rarer species encountered either in terms of annual catch (cod 0.01 to 0.09 t) or in terms of only occasionally appearing in the catch in any one year (haddock, pollock, white hake).

Sources of Uncertainty

This is the first time that the depletion analysis method has been applied to these data. The assumptions of no recruitment, natural mortality and minimal growth during the period of the fishery have not been tested. In addition, the assumption of all scallops of commercial size being equally vulnerable to the fishery has not been tested.

The apparent lack of population dynamics information in survey estimates needs to be addressed to validate the analysis of the commercial catch rate data. The surficial bottom type maps are currently being revised to account for sidescan sonar and seismic data. The survey data will be re-analyzed when these new maps are available.

The reliability of the 2007 bycatch estimates was lower than that for previous years due to lower observer coverage.

Little is known about the recruitment or total mortality of scallops in this area.

CONCLUSIONS AND ADVICE

There are two main signals that can be attributed to stock status from the annual surveys. First, there do not appear to be large numbers of scallops in the 90–99 mm shell height range that will recruit to the fishery in 2008 and therefore, the abundance of commercial size scallops in 2008 is not expected to be greater than it was in 2007. Second, the next above-average year-class expected to recruit to the fishery will not be in the ≥100 mm shell height range until 2010 or 2011 and therefore, the population numbers of commercial size scallops are expected to stay the same or decline until then depending upon the rates of exploitation and natural mortality over the next two years.

Using the information from growth curves and the mean meat weights from sampling the commercial catches, growth in biomass is expected to be in the range of 7 to 16% for the different subareas for 2008. At present we do not know enough about the balance between growth, recruitment and natural mortality for scallops in these subareas to determine catch levels based upon surplus production. In the Bay of Fundy, a level of less than 0.2 for exploitation appears to result in increased or stable population biomass on average (DFO 2008); however, the meat sizes in the fisheries in this area tend to be smaller than in SFA 29 with a higher potential growth rate.

Keeping exploitation in 2008 at levels in the range of the expected growth in biomass in Subareas B, C and D should result in small or negligible declines in population biomass assuming that recruitment just balances off losses due to natural mortality. That is, catches in 2008 should be in the order of 65, 22, and 61 t in Subareas B, C and D, respectively (Table 2). Applying the same rationale to subarea A would result in a recommended catch of less than 1 t in Subarea A. As noted earlier, the exploitation estimate for Subarea A probably does not reflect the area as a whole and the recommended catch could be higher. However, given the high densities of the 2005/2006 year-class were observed in subarea A, the fishery should be limited there to improve the survival of the young scallops in this area.

Table 2. Expected gain in biomass from 2007 to 2008 due to growth for each subarea of SFA 29. Median B_0 is the estimated biomass of commercial size scallops prior to the 2007 fishery and was estimated from the depletion model. Estimated biomass after the 2007 fishery assumes removals by the fishery only.

subarea	median B_0	Landings *2007 (t)*	Biomass (t) *after 2007 fishery*	Expected Gain *from Growth (t)*
A	18.9	11.5	7.4	0.7
B	598.8	79.9	518.9	64.9
C	252.3	58.9	193.4	22.2
D	513.6	95.4	418.2	60.7

There was not enough survey information to recommend catch levels for Subarea E. Scallop landings from this subarea have ranged from 0 to 11 t since this fishery opened in 2001, and it is likely that the habitat in this subarea is marginal for scallop.

OTHER CONSIDERATIONS

During the July–October molting period, lobsters are less mobile, more prone to injury, and involved in mating. Measures have been taken to avoid scallop fishing in areas where, or at times when, lobsters are in high concentrations or are soft-shelled. The closure of a portion of Subarea B in previous years due to high lobster bycatch has been an example of the type of measure that could be employed.

SOURCES OF INFORMATION

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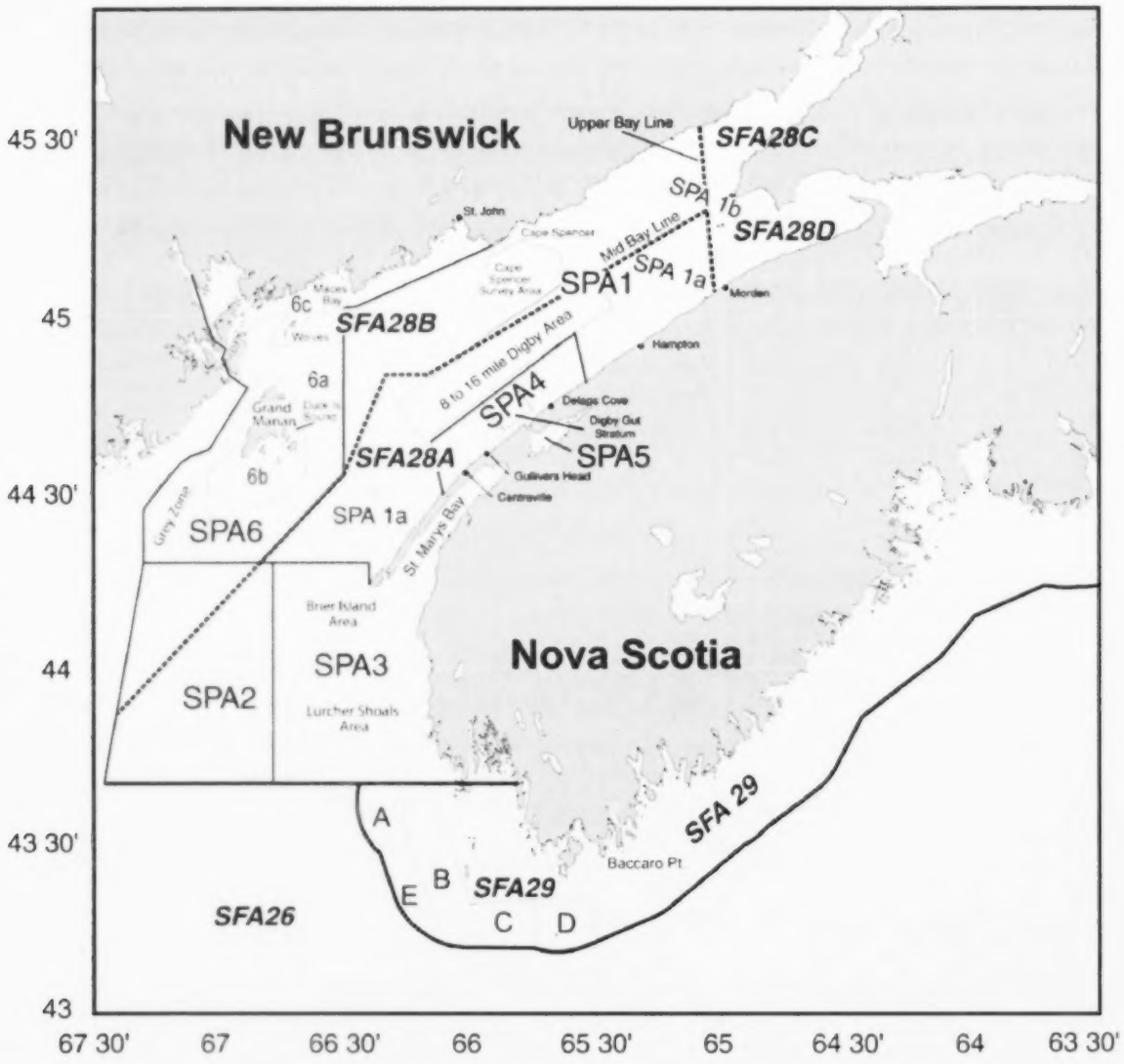
Appendix 1. Locations and place names for inshore scallop grounds.



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